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Nativity Status and Dietary and Physical Activity Behavior among United States Adults: Findings from the Health Information National Trends Survey (HINTS 4 Cycle 3)

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By

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LIST OF ABBREVIATIONS

ACA: Affordable Care Act

AHA: American Heart Association

AOR: Adjusted Odds Ratio

BMI: Body Mass Index

CPS: Current Population Survey

FGDs: Focus Group Discussions

HIE: Healthy Immigrant Effect

HINTS: Health Information National Trends Survey

IRB: Institutional Review Board

NCDs: Non-communicable Diseases

NCI: National Cancer Institute

95% CI: Ninety-five percent Confidence Interval

SD: Standard Deviation

TV: Television

U.S: United States

Ha: Alternative Hypothesis

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ABSTRACT

Background: Non-communicable diseases and chronic conditions continue to emerge as public health crises in the United States (U.S.) and globally. Obesity, one of the most notable of such conditions, is associated with significant morbidity and mortality. Compared to non-immigrants, U.S. immigrants are known to have lower risks of obesity. However, there is paucity of literature on how U.S. immigrants compare to native-born adults regarding obesity-related behavior.

Objective: We aim to describe demographic characteristics, weight distribution, and distributions of specific obesity-related behaviors among immigrant and native-born U.S. adults. Secondarily, we aim to estimate associations between nativity status and obesity-related behavior among U.S. adults.

Methodology: We analyzed data from the Health Information National Trends Survey conducted between September and December 2013 (HINTS 4 Cycle 3). The independent variable was nativity status (immigrant vs. native-born). Outcomes of interest were indicators of dietary behavior (fruit, vegetable, and soda intake) and indicators of physical activity level (sitting time spent on television/computer games/web surfing, participation in physical exercise, and participation in muscle training exercise). Bivariate analyses and multivariable logistic regression models were utilized in describing demographics, weight distribution, and associations between variables of interest. Statistical significance was determined using *p*-values < 0.05 and 95% CI around adjusted odds ratios.

Results: A total of 3185 individuals participated in the survey. The overall male to female ratio was 1:1.6. Approximately 17% of participants were immigrants and roughly 83% were native-born U.S. adults. The mean age was 51 years (SD +/- 15) for immigrants and 55years (SD+/-16)

for native-born respondents. Among immigrants, the racial distribution was 55.3% Hispanic, 18.9% Asian, 14.7% White, 9.9% Black and 1.3% other races. About 25% of immigrants were obese, compared to 34% of non-immigrants. Immigrants were more likely than native-born respondents to take some quantity of fruit daily (adjusted OR = 1.88; 95% CI: 1.07 - 3.32; p = 0.0290); and less likely than native-born respondents to consume soda every week (adjusted OR = 0.74; 95% CI: 0.55 - 0.98; p = 0.0383). Immigrants were less likely than non-immigrants to spend 6 hours or more a day on sedentary leisure activities (adjusted OR = 0.64; 95% CI: 0.42 - 0.97; p = 0.0350). Immigrants were also more likely than non-immigrants to engage in physical activity of at least moderate intensity, at least once a week (adjusted OR = 1.48; 95% CI: 1.07 - 2.05; p = 0.0192).

Conclusion: Compared to non-immigrants, U.S. immigrants appear to have a tendency towards healthier lifestyles regarding diet and physical activity behavior. Strategies to sustain such tendencies among immigrants will promote health and reduce risks of obesity, cancer and other chronic diseases in the U.S. More robust studies are needed to shed more light on various socio-economic, cultural and demographic factors that influence proximal determinants of obesity.

Keywords: Nativity Status, Immigrant, Native Born, Obesity-Related Behavior, Diet, Physical Activity.

CHAPTER I: INTRODUCTION

1.1 Background

Non-communicable diseases (NCDs) and chronic conditions continue to emerge as public health crises in the United States (U.S.) and globally.[1] One of the most prominent of such is obesity, a major chronic condition associated with many adverse health outcomes.[2] Obesity is defined as a body mass index (BMI) equal to or greater than 30kg/m^2, and more than a third (roughly 35%) of adults in the U.S. is obese.[3] Obesity is associated with significant morbidity and mortality, resulting in huge economic costs for the individual and for the nation. Cardiovascular disease, hyperlipidemias, type 2 diabetes mellitus, sleep disorders and depression are more common among obese people compared to the general population; and in 2012, an estimated $190.2 billion (21% of annual U.S. medical spending) was projected for obesity related illnesses.[2]

Individuals' lifestyle choices have an impact on their BMI, and obesity could be the consequence of a number of lifestyle choices, collectively known as obesity-related behavior. Studies have established the remarkable impact of positive health behavior (including appropriate diet and physical exercise) in reducing obesity rates in general.[4,5]

In the meantime, immigration to the U.S. is on a steady increase. The population of immigrants in the U.S. increased from 9.6 million in 1970 to 31.1 million in 2000;[6] and immigrants currently represent a substantial population group in the U.S.[7] Research shows that in spite of lower income and educational attainment, adult U.S. immigrants have lower risks of obesity compared their native-born counterparts; especially in the early years of immigration.[8,9] However, there is a paucity of data in the literature exploring differences that may exist in

obesity-related behavior between immigrants and native-born U.S. adults. Specifically, data comparing immigrants and non-immigrants as regards proximal determinants of obesity is very limited.

In view of the steady increase in the number of U.S. immigrants, and the evidence supporting lower risks of obesity among immigrants, it is important to explore and characterize any dissimilarity that may exist in obesity-related behavior, comparing immigrants to native-born U.S. adults. Good knowledge and understanding of any such dissimilarity will help policy makers and public health practitioners in formulation of policies and tailoring of messages to effectively reduce the risk of obesity in the U.S. populace.

The current thesis uses a nationally representative sample of U.S. adults to explore and report proximal determinants of obesity (dietary and physical activity behavior), comparing U.S. immigrants to non-immigrants. It will add to the research on obesity in the U.S. by providing data that can inform appropriate recommendations for specific and targeted interventions.

1.2 Purpose of Study

The purpose of this study is to describe demographic characteristics, weight distribution, as well as distributions of specific obesity-related behavior (diet and physical activity) in a nationally representative sample of U.S. adults surveyed in 2013. Secondarily, we aim to estimate associations between nativity status (immigrant vs. native-born) and specific obesity-related behavior (diet and physical activity) among adults in the U.S. Finally, we aim to evaluate the impact of length of stay of U.S. immigrants on diet and physical activity behaviors.

1.3 Research Questions and Hypothesis

The following three research questions were explored along with the stated hypotheses:

1. Do adult U.S. immigrants engage in healthier dietary behavior than native-born U.S. adults?

   Ha1**:** Adult U.S. immigrants will report engaging in healthier dietary behaviors than native-born U.S. adults.

2. Do adult U.S. immigrants engage in more physical activity than native-born U.S. adults?

   Ha2: Adult U.S. immigrants will report engaging in more physical activity than native-born U.S. adults.

3. Does length of stay of U.S. immigrants have an impact on dietary and physical activity behaviors?

   Ha3: Adult U.S. immigrants who report residing in the U.S. for 10 years or more will have dietary behaviors similar to those of native-born U.S. adults.

   Ha4: Adult U.S. immigrants who report residing in the U.S. for 10 years or more will have physical activity behaviors similar to those of native-born U.S. adults.

1.4 Theoretical Framework

The 'healthy immigrant' effect (HIE) posits that new immigrants tend to be healthier than both the native-born populace and immigrants who have lived in the nation for longer periods of time. HIE can be viewed as paradoxical because compared to non-immigrants, many immigrants are of lower socioeconomic status and originate from developing countries. However, several studies have tested and validated the HIE theory.[10-12] Plausible explanations proffered for HIE in literature include the selective nature of immigration policies of developed countries, including

mandatory health and fitness screening requirements.[13]

Based on the HIE, we hypothesize that adult U.S. immigrants engage in healthier dietary behavior and more physical activity than native-born U.S. adults. Although unlikely to be the sole reasons, healthier dietary behavior and more physical activity would be expected to contribute to the lower risks of obesity observed among immigrants, compared to native-born U.S. adults.

We also postulate that compared to newer immigrants, immigrants with longer length of stay in the U.S. have dietary and physical activity behavior more similar to those of native-born U.S. adults. It is known that most immigrants eventually adopt lifestyle choices similar to those of native-born U.S. adults through acculturation, and the length of stay in the U.S. would be expected to have an impact on the rate and process of acculturation. Hence, dietary and physical activity routines of immigrants would be expected to get more similar to those of native-born residents as length of stay in the U.S. increases, and research has shown the acculturation process for U.S. immigrants is quite well established within 10 to 15 years of immigration to the country.

CHAPTER II: LITERATURE REVIEW

2.1 Obesity in the U.S.

With increasing medical costs in the U.S. and globally,[14] diseases and conditions that contribute significantly to health care costs are receiving more attention. The comprehensive health care reform in the U.S, known as the Affordable Care Act (ACA), was aimed at a reduction of about $600 billion in the costs of the American health care system in the first decade alone.[15] Due to improvements in technology and in health care practices, NCDs and chronic conditions such as obesity have dominated the health care landscape for decades, and are projected to exact the majority of health care costs.[1]

Defined as a body mass index (BMI) of 30kg/m^2 or more, obesity is a notable chronic condition with significant health consequences of major economic importance. BMI is measured as weight in kilograms divided by the square of height in meters.[16] About 72 million U.S. adults and 17% of U.S. children are obese.[17] Some of the adverse health outcomes of obesity include type 2 diabetes, hypertension, stroke, heart disease, osteoarthritis, fertility problems, liver disease, gallbladder disease, and some types of cancer.[2,18] In 1991, an estimated 280,184 deaths in the U.S. was attributed directly to obesity.[19] More recent data indicates that obese adults have 20% or more significantly higher rates of all-cause mortality.[20] Obesity is therefore a chronic condition that warrants continued public health attention, and that should be tackled from all possible angles.

The prevalence of obesity in the U.S. is known to differ among groups and sub-populations.[21] Hence, determination of risks specific to sub-populations as well as comparisons of obesity-related behavior among diverse groups will promote planning of targeted interventions for health promotion and disease prevention.

2.2 Obesity-related Behavior

Numerous studies have explored factors related to the etiology of obesity. These factors have been broadly categorized as genetic, environmental and behavioral.[22] Behavioral factors are lifestyle choices that either promote or prevent obesity, and constitute part of the multifaceted proximal determinants of obesity. Balanced caloric intake and regular physical activity are among the well-recognized lifestyle choices that prevent overweight and obesity.[23] It is believed that overweight and obesity result from an energy imbalance: a combination of consumption of too many calories (especially from unhealthy food types) and inadequate physical activity. There is clearly a genetic component to the development of obesity, particularly among people who are very heavy,[24] but behavioral factors represent the most modifiable factors contributing to the incidence and prevalence of obesity. As such, interventions aimed at modifying behavioral factors (especially those that are proximal determinants of obesity) will have significant impact on prevention and reduction of obesity risks. The World Health Organization framework for the implementation of the Global Strategy on Diet, Physical Activity and Health emphasizes the role of governments in formulating policies that improve food and physical activity environments to make healthy eating and physical activity choices easier for the populace.[25] Such policies, for example, would do well to address facilitation of fruit and vegetable consumption among various racial and ethnic sub-populations. Consumption of fruits and vegetables is a healthy dietary choice that has been shown to decrease obesity, enhance weight management and improve outcomes in cardiovascular disease.[26]

2.3 U.S. Immigration Trends

Foreign born individuals constituted 13% of the 2012, and 16% of the 2013 American population.[27] The immigrant population in 2013 was estimated at about 41.3 million. This

number is double, almost triple and about quadruple the 1990, 1980, and 1970 immigrant population numbers respectively.[28] The number of immigrants in the U.S. at present is greater than at any time in the past and currently, there are about one million new arrivals per year. Based on the steady increase in immigration over the past few decades, it is projected that by 2050, almost 20% of Americans (i.e. one in every five) will be immigrants.[29] The banking industry, Silicon Valley and academia continue to attract highly skilled immigrants, while less skilled immigrants participate in significant numbers in the blue collar industries of manufacturing, agriculture, food processing, as well as in other industries less appealing to native-born workers.[30] Incorporating large numbers of newcomers has cost implications for the nation, including costs of healthcare, hospitals, welfare, social services and other special programs for immigrants. In order to promote health and prevent disease among the rapidly expanding U.S. immigrant population, public health researchers and practitioners need to direct attention to specific conditions for which immigrants are at high risk and to tailor interventions toward such conditions.

2.4 U.S. Immigrants and Obesity

Compared to native-born U.S. adults, U.S. immigrants have been shown to have lower obesity risks, especially in the first few years following immigration. Antecol et al. found that at entry into the U.S., female and male immigrants had obesity rates roughly two and five percentage points lower than native-born women and men respectively.[31] This observed lower risk of obesity cuts across various immigrant subgroups, including Latinos,[9] Asians,[32] and persons of African descent.[33] Furthermore, the observed lower risk of obesity among immigrants holds true in spite of lower income and educational attainment.[8,9] The latter finding is somewhat at variance with the established direct correlation between lower socioeconomic/educational

indices and the prevalence of obesity in native-born U.S. residents. Explanations proffered in literature for this "immigrant paradox" include a 'healthy immigrant' effect (HIE), the protective influence of strong social networks and family ties, and even a reporting bias.[34] The observed lower risk of obesity among U.S. immigrants is all the more interesting in the light of increasing rates of obesity in countries like Mexico that account for a high proportion of immigrants to the U.S.[35]

However, morbidity and mortality risks from various diseases and conditions eventually change for immigrants as their length of residence in the U.S. increases, [36] and obesity is no exception. The risk of obesity among immigrants is known to increase as the length of stay increases. In their study, Antecol et al. further reported that female and male immigrants gain enough weight to develop obesity rates comparable with that of native-born Americans, within 10 and 15 years of arrival respectively. [31] Moreover, similar to the observed lower risk of obesity for immigrants at entry, the observed increased risk of obesity with increased length of residence also cuts across various immigrant subgroups. A study found that Latinos who had stayed in the U.S. for 15 or more years developed about a four-fold risk of obesity compared to those with less than 5 years of stay.[37] Another study observed that immigrant women of Puerto Rican origin who had been in the U.S. for 10 years or more had a 40% prevalence of obesity, compared to a prevalence of 29% for those who had been in the U.S. less than a year.[38] Furthermore, in a nationally representative sample of 5,230 U.S. immigrants of various racial and ethnic sub-groups, there was a direct correlation between length of residence and risk of obesity; 15 or more years was associated with increased risk of obesity (OR 1.31; 95% CI 1.03-1.65).[39]

2.5 U.S. Immigrants and Obesity-related Behavior

Acculturation is the process by which after immigration, immigrants adopt the norms, behaviors and practices of the dominant culture. There is evidence for acculturation among U.S. immigrants as length of residence in the nation increases; and this can lead to the adoption of lifestyle choices that in turn increase their risks of obesity from the baseline of substantially lower risks.[40] Also, additional evidence for acculturation derives from the notable increases in obesity risks observed in successive generations of immigrants.[41]

An individual's BMI is influenced by proximal (caloric intake and physical activity) and distal (cultural attitudes and practices) factors, which have also been linked to obesity trends in populations. Researchers have placed emphasis on distal factors in the acculturation process, and various studies have examined the role of cultural attitudes and practices among U.S. immigrants. Changes in culture are believed to influence weight gain, leading to increased obesity rates among immigrant groups as length of stay in the U.S. increases, as well as among successive generations of immigrants.[38,42] In contrast however, the literature is limited regarding the contributions of proximal determinants of obesity (such as diet and physical activity) to the observed increase in obesity risks as length of stay increases.

Only a few studies have explored probable baseline differences in diet and physical activity behavior between immigrants and native-born U.S. adults, as well as how these behavioral determinants of obesity change with length of stay in the U.S.[43] One such study, conducted in 2013, employed focus group discussions (FGDs) among Brazilian, Latin American and Haitian immigrant women, as part of a community based participatory intervention program.[44] Participants (recent immigrants) were asked about their diet and physical activity levels in the U.S. compared to their home countries. They expressed that although there is more food variety,

food in the U.S. is "less natural" and there is less time for preparation. They also stated that the U.S. weather represents an obstacle to physical activity. The authors highlighted that there are differences in diet and physical activity behaviors between immigrants and native-born U.S. adults and suggested attention should be given to individual modifiable risk factors for obesity among recent immigrants. Another study, evaluating diet and exercise counseling, found that immigrants were less likely than native-born U.S. adults to discuss their dietary (18% vs 24%) and physical activity (19% vs 23%) routines and concerns with health care providers.[45] The study emphasized the importance of early intervention with diet and physical activity in preventing weight gain, obesity, and related chronic illnesses among immigrant subgroups.

Evidently, strategies to maintain the lower risk of obesity observed among U.S. immigrants in the early years would be good targets for intervention, and should be a public health priority. Such strategies however cannot be developed without a robust understanding of factors that contribute to the lower risk in the early years of immigration. Research exploring various aspects of obesity-related behavior (especially proximal determinants of obesity) among immigrants is therefore essential.

CHAPTER III: METHODS

3.1 Overview

The Health Information National Trends Survey (HINTS) is a survey of a nationally representative sample of civilian non-institutionalized individuals in the U.S, who are 18 years or older. The survey includes identifiers for immigrants. Started in 2003, it is conducted biennially by the National Cancer Institute (NCI) and it is used to monitor changes in the health information of the American populace. The HINTS program collects data on the American public's need for, access to, and use of health-related information; as well as data on health-related behaviors, perceptions and knowledge.[46] HINTS 4 Cycle 3 was conducted by mail from September 2013 through December 2013, using a protocol similar to that utilized in previous cycles.[47] The vast majority of the survey items in the HINTS questionnaires are derived from instruments used for evaluation of general health in existing national-level surveys. Although a lot of attention is given to cancer, other domains assessed by the survey include nutrition and dietary behavior, physical activity, food security, health status, health care, and health information seeking.

The current thesis employed secondary analysis of the HINTS 4 cycle 3 dataset and was conducted under Georgia State University Institutional Review Board (IRB)-exempted protocols. The written report presented gives statistics for variables of interest (demographics and proximal determinants of obesity) obtained from the dataset.

3.2 Variables and Specifications

Dependent Variables: The dependent variables evaluated for the analyses included several indicators of the usual dietary behavior and physical activity level of participants, as well as BMI.

For dietary behavior, we selected and examined intake of fruits, vegetables and soda by utilizing the following survey items respectively:

(1) “About how many cups of fruit (including 100% pure fruit juice) do you eat or drink each day?” Response options in the questionnaire included “none,” “½ cup or less,” “½ cup to 1 cup,” “1 to 2 cups,” “2 to 3 cups,” “3 to 4 cups,” and “4 or more cups.” The HINTS dataset variable ‘fruit’ was re-coded to produce a 4-level categorical variable (‘none,’ ‘up to 1 cup per day,’ ‘1 to 3 cups per day,’ and ‘3 or more cups per day’) for bivariate analyses; and a dichotomous variable (‘some fruit intake daily,’ and ‘none’) for multivariable analyses.

(2) “About how many cups of vegetables (including 100% pure vegetable juice) do you eat or drink each day?” The choice of responses was identical to those for daily fruit intake and the dataset variable ‘vegetables’ was re-coded to produce a 4-level categorical variable (‘none,’ ‘up to 1 cup per day,’ ‘1 to 3 cups per day,’ and ‘3 or more cups per day’) for bivariate analyses; and a dichotomous variable (‘some vegetable intake daily’ and ‘none’) for multivariate analyses.

(3) “Not counting any diet soda or pop, about how often do you drink regular soda or pop in a typical week?” Response options included “every day,” “5-6 days a week,” “3-4 days a week,” “1-2 days a week,” “Less often than 1 day a week” and “I don't drink any regular soda or pop.” These response categories for the variable “RegularSodaWeek” were maintained for bivariate analyses, but the variable was dichotomized (‘some soda intake weekly’ and ‘none’) for multivariate analyses.

Indicators selected to represent the usual physical activity level of participants included sitting time spent on television (TV)/computer games/web surfing, participation in physical

exercise of at least moderate intensity, and participation in muscle training exercise. For these, the following survey items were examined respectively:

(1) "Over the past 30 days, in your leisure time, how many hours per day, on average, did you sit and watch TV or movies, surf the web, or play computer games?" Responses were reported in hours, and a 4-level categorical variable, created from re-coding of the dataset variable "AverageDailyTVGames" was used in bivariate analyses. The four newly created categories were "none," "less than 5 hours per day," "5 to 14 hours per day," and "15 or more hours per day."

(2) "In a typical week, how many days do you do any physical activity or exercise of at least moderate intensity, such as brisk walking, bicycling at a regular pace, and swimming at a regular pace?" Response options in the survey were "none," "1 day per week," "2 days per week," "3 days per week," "4 days per week," "5 days per week," "6 days per week," and "7 days per week." The dataset variable "TimesModerateExercise" was re-coded to create a 3-level categorical variable ('none,' '1 to 3 times per week,' and '4 or more times per week') which was used for bivariate analyses. The variable "TimesModerateExercise" was also dichotomized ('at least one day per week,' and 'none') for multivariable analyses. For participants who reported taking part in some form of moderate intensity exercise at least once a week, the follow up questions included the survey item "On those days, how long are you typically doing these activities?" The dataset variable "HowLongModerateExerciseMn" reported the responses in minutes and it was re-coded into a 3-level categorical variable ('less than 30 minutes per day,' '30 to 60 minutes per day,' and 'more than 60 minutes per day') for bivariate analyses.

(3) “In a typical week, how many days do you do leisure-time physical activities specifically designed to strengthen your muscles?” Response options included “none,” “1 day per week,” “2 days per week,” “3 days per week,” “4 days per week,” “5 days per week,” “6 days per week,” and 7 days per week.” The variable “TimesStrengthTraining” was dichotomized (‘some muscle-strengthening exercise every week’ and ‘none’) for multivariable analyses.

BMI was a derived variable made available in the HINTS 4 cycle 3 dataset. It was calculated from the following two survey items: “About how tall are you without shoes?” (Response was supplied in feet and inches), and “About how much do you weigh, in pounds, without shoes?” The dataset variable “BMI” was a continuous variable. It was re-coded to produce a 4-level categorical variable: Underweight (BMI <18.5**),** Normal weight (BMI 18.5 - 24.9), Overweight (BMI 25 - 29.9**)** and Obese (BMI ≥30). The new categorical BMI variable was used in bivariate analyses.

Independent Variables: The independent variable of main interest in the analyses was the nativity status of participants: immigrant versus native-born. The HINTS dataset variable “BornInUSA” was a dichotomous variable obtained from the survey item “Were you born in the United States?” The response options were “Yes” and “No”. For participants who responded “No” (i.e. immigrants), one of the follow up survey items was “In what year did you come to live in the United States?” Immigrants were to supply their responses to this survey item by indicating the year of entry into the U.S., generating the continuous variable “YearCameToUSA.” The variable “BornInUSA” was maintained in its original form for all our analyses, while “YearCameToUSA” was dichotomized (‘less than 10 years,’ and ‘10 years or more’).

Covariates: Covariates in our analysis included the following: gender (male; and female), age categories (18-34 years; 35-49 years; 50-64 years; and 65 years or more), level of education (less than high school; high school graduate or some college; and college graduate or higher), race/ethnicity (Non-Hispanic White; Non-Hispanic Black; Non-Hispanic Asian; Hispanic and Other), income ranges (less than $10,000; $10,000 - $49,999; $50,000 - $99,000; and 100,000 or more), and marital status (married or living as married; not married and not living as married). These categories of the covariates were obtained by re-coding of the following dataset variables respectively: "GenderC," "AgeGrpB," "EducA," "RaceEthn," "IncomeRanges," and "MaritalStatus." We also included disability status (obtained from the dichotomous dataset variable "Disabled") as an additional covariate in our analysis.

3.3 Data Analysis

All analyses were done using SAS 9.3 (SAS Institute, Cary NC). We performed bivariate analyses, the results of which we utilized to describe the distribution of socio-demographic characteristics of survey participants by nativity status. We used Wald Chi-Square tests (for categorical variables), and t test for differences in means (for the continuous variable 'age'), to determine differences in distributions of demographic variables among immigrants and non-immigrants; and *p*-values <0.05 were taken as statistically significant. Furthermore, bivariate analyses results were utilized to describe dietary and physical activity behavior as well as BMI distribution among immigrants and non-immigrants; and *p*-values <0.05 were taken as statistically significant. Additionally, we used multivariable logistic regression models to obtain adjusted odds ratios (AOR) and 95% confidence intervals (95% CI) for associations between nativity status and various outcomes of interest. The various outcomes were taken as indicators

of usual dietary and physical activity behavior among participants and included fruit intake, vegetable intake, soda intake, average time spent on TV/games/web surfing, participation in moderate intensity exercise and participation in strength training exercises. In each multivariable model, dummy variables were created for multi-level categorical variables, and statistical adjustments were made for gender, age group, race/ethnicity, level of education, marital status, and income ranges. Furthermore, we created additional multivariable logistic regression models in which adjustments were made for disability status when considering physical exercise and muscle training exercise as outcomes. For these additional models, the dichotomous HINTS variable 'Disabled' (with responses 'Yes' and 'No') was utilized. The variable 'Disabled' was derived from responses of participants to specific survey items that inquired about various forms of disability including blindness, deafness, difficulty with walking/ dressing/ bathing/ errands, as well as emotional disability. In all our multivariable models, p-values < 0.05 and 95% CI around adjusted odds ratios were used to determine statistical significance.

CHAPTER IV: RESULTS

4.1 Demographic Characteristics

A total of 3185 individuals participated in the HINTS 4 cycle 3 survey. Sixty-one percent of participants were female, giving an overall male to female ratio of 1:1.6. The mean age in the entire cohort was 54.68 years (SD +/- 16.5). Most participants (34.72%) were in the 50-64 year age category, 28.36% were 65 years or older, 23.10% were in the 35-49 year age category, and 13.82% were in the 18-34 year age category (Figure 1a). About 58% of survey participants were White, 18.75% were Hispanic, 15.45% were Black, 4.18% were Asian and 3.49% were of other races. Approximately 52% of respondents were married or living with a partner as married. Also, 52.71% of participants were high school graduates or had attended some college, 37.69% had college degrees or higher and 9.59% had less than high school education (Figure 1b). An estimated 52.24% of respondents were employed, 5.97% were unemployed, 41.79% were either retired or not in the work force (disabled, homemaker or student). The $10,000 - $49,999 income range was the most predominant in the entire cohort (44.91%), followed by the $50,000 - $99,999 income category (28.48%). Seventeen percent of participants made $100,000 or more per annum, while 9.57% of participants made less than $10,000 per annum (Figure 1c). About 66% of participants reported home ownership.

As shown in Figure 2a, approximately 17% of participants were immigrants (n = 533), while 83% were native-born (n = 2598). About 60% of immigrants and 62% of native-born respondents were female. Female native-born respondents constituted about half (51.5%) of all participants in the survey. The mean age for immigrants was 51 years (SD +/- 15), and that for native-born participants was 55 years (SD+/-16). Majority of the immigrants (33.8%) were in the

35-49 year age category, while majority of native-born respondents (35.5%) were in the 50-64 year age category. Among immigrants, the second most common age group was the 50-64 year category (roughly 30.8%), while the 65+ category was the second most common among the native-born, accounting for 30%. The 18-34 year age category had the least numbers of respondents among both immigrants and native-born participants. Majority of immigrants (55.3%) were Hispanic, while most native-born respondents (67.3%) were White. The distribution among Non-Hispanic immigrant respondents was as follows: 18.9% Asian, 14.7% White, 9.9% Black and 1.3% other races. Approximately 60% of immigrants, compared to 50% of native-born respondents, were married or living as married.

About 39% of immigrants had college degrees or higher, compared to 37.4% of native-born participants. Roughly 21% of immigrants had less than high school education compared to 7.2% of native-born respondents (Figure 2b). Regarding occupational status, 54.9% of immigrants were employed compared to 51.7% of native-born respondents. Eleven percent of immigrants were unemployed, compared to 4.9% of native-born participants. Sixty-three percent of immigrants compared to 52% of native-born respondents had total income less than $50,000 per annum. About 13% of immigrants, compared to 8.7% of non-immigrants earned less than $10,000 per annum. Approximately 12% of immigrants and 18% of non-immigrants earned $100,000 or more per annum (Figure 2c). Forty-eight percent of immigrants reported owning their homes compared to 69% of native-born respondents.

Among immigrants, 82.64% had lived in the U.S. for more than 10 years, 10.74% had lived in the U.S. for 6 to 10 years and 6.61% had lived in the U.S. for 5 years or less.

4.2 Distributions of Weight, Diet and Physical Activity by Nativity Status

Table 2 shows BMI categories by nativity status, as well as distributions of diet and physical activity variables by nativity status of participants. The variables presented were chosen as specific indicators of the dietary behavior and physical activity level of participants, as previously described in section 3.2.

Regarding BMI, 33.06% of participants in the entire cohort (n = 3064) was obese and 33.78% was overweight. Most immigrants (36.3%) were in the normal weight category while most native-born respondents (34.4%) were in the obese category. An estimated 25.65% of immigrants were obese compared to 34.4% of native-born respondents (Figure 3).

Most immigrants (44.6%) had a daily fruit intake of 1 to 3 cups per day, while most native-born participants (44.2%) had a daily fruit intake of up to 1 cup per day. Only 5.6% of immigrants and 7.5% of the native-born took 3 or more cups of fruit daily. Approximately 7% of immigrants and 8% of the native-born did not take any quantity of fruit daily. For vegetable intake, most participants took 1 to 3 cups per day: 44.1% of immigrants vs. 46.8% of the native-born. About 5% of immigrants and 4.8% of the native-born did not take any quantity of vegetables daily. About 16% of immigrants and 19% of non-immigrants reported taking soda on 3 or more days per week, while 7.3% of immigrants and 9% of the native-born reported taking soda every day. Thirty-seven percent of immigrants and 41.9% of the native-born reported not taking soda at all.

Most participants in the cohort spent less than 5 hours per day (on the average) sitting to watch TV, play computer games or surf the web: 80.4% of immigrants and about 71.7% of the native-born. One percent of immigrants and 1.6% of native-born respondents spent 15 hours or

more per day on these leisure activities. About 42% of immigrants and 38.3% of native-born participants took part in physical exercise of at least moderate intensity 1 to 3 times per week. Meanwhile, 22.6% of immigrants and 26.3% of native-born participants did not engage in physical activity of at least moderate intensity. Among participants who had some weekly exercise of at least moderate intensity, the commonest length of exercise time was 30 to 60 minute per day; 73.2% of immigrants and 76.2% of the native-born who exercised were in this category. Also, 46.36% of immigrants vs. 43.26% of native-born participants took part in muscle strength training exercises at least once a week; while 53.64% of immigrants vs. 56.74% of native-born respondents did not engage in any form of muscle training exercise.

4.3 Associations between Nativity Status and Outcome Variables of Interest

Three separate multivariable logistic regression analyses were performed to estimate associations between nativity status and fruit intake, nativity status and vegetable intake, as well as nativity status and soda intake (Table 3).

After adjusting for gender, age group, race/ethnicity, level of education, marital status and income category, immigrants were more likely than native-born respondents to take some quantity of fruits daily (Adjusted OR = 1.88; 95% CI: 1.07 - 3.32; $p = 0.0290$). Although immigrants were also more likely than native-born participants to take some vegetables daily, the association was not statistically significant (Adjusted OR = 1.29; 95% CI: 0.68 - 2.47; $p = 0.4372$). Furthermore, immigrants were less likely than native-born respondents to consume soda every week (Adjusted OR = 0.74; 95% CI: 0.55 - 0.98; $p = 0.0383$).

Our multivariable analyses also revealed that female participants were more likely than males to take some quantity of vegetables daily (Adjusted OR = 1.76; 95% CI: 1.17 - 2.65; $p = 0.0065$). We found no significant difference in consumption of fruits and vegetables by age

category but respondents with at least a college degree were more likely to have some daily intake of fruits (Adjusted OR = 2.19; 95% CI: 1.16 - 4.09; $p = 0.0137$) and some daily intake of vegetables (Adjusted OR = 2.31; 95% CI: 1.13 - 4.73; $p = 0.0217$). There was no statistically significant difference in daily fruit consumption by income category but respondents who earned $100,000 or above were more likely to take vegetables daily (Adjusted OR = 2.575; 95% CI: 1.00 - 6.58; $p = 0.0481$)

Females were less likely than males to take soda every week (Adjusted OR = 0.60; 95% CI: 0.50 - 0.72; $p < .0001$). Also, older participants were less likely to take soda every week, and this finding was especially notable when comparing the 50 – 64 year age category (Adjusted OR = 0.56; 95% CI: 0.43 - 0.74; $p < .0001$) and the 65+ age category (Adjusted OR = 0.38; 95% CI: 0.29 - 0.51; $p < .0001$) to the 18 – 34 year age category. Respondents with at least a college degree were less likely to drink soda every week (Adjusted OR = 0.57; 95% CI: 0.39 - 0.84; $p = 0.0044$). Respondents with an annual income of $100,000 or above were also less likely to drink soda every week (Adjusted OR = 0.52; 95% CI: 0.34 - 0.78; $p = 0.0015$). Compared to Caucasians, Hispanics (Adjusted OR = 2.00; 95% CI: 1.50 - 2.65; $p < .0001$) and Blacks (Adjusted OR = 2.76; 95% CI: 2.08 - 3.64; $p < .0001$) were more likely to consume soda on a weekly basis.

Furthermore, we conducted three separate multivariable logistic regression analyses for associations between nativity status and time spent on sedentary leisure activities, nativity status and moderate intensity physical exercise, as well as nativity status and muscle strength training. After adjusting for gender, age group, race/ethnicity, level of education, marital status and income category, immigrants were less likely than native-born respondents to spend 6 hours or more a day sitting to watch TV, play computer games and/or surf the web (Adjusted OR = 0.64;

95% CI:0.42 - 0.97; p = 0.0350). Also, immigrants were more likely than native-born respondents to engage in physical activity of at least moderate intensity, at least once a week (Adjusted OR = 1.48; 95% CI: 1.07 - 2.05; p = 0.0192). Additionally, although the association was not statistically significant, immigrants were more likely than native-born participants to engage in muscle strength training at least one day per week (Adjusted OR = 1.28; 95% CI: 0.98 - 1.67; p = 0.0757).

Our multivariable analyses also revealed that participants in the 65+ age group were more likely to spend 6 or more hours per day sitting down for leisure activities (Adjusted OR = 1.71; 95% CI: 1.16 - 2.52; p = 0.0066). Black participants were also more likely to engage in sedentary leisure activities for 6 or more hours per day (Adjusted OR = 1.73; 95% CI: 1.28 - 2.35; p = 0.0004). Meanwhile, participants who earned $100,000 or above were less likely to spend 6 or more hours on sedentary leisure activities (Adjusted OR = 0.45; 95% CI: 0.26-0.80; p = 0.0061).

Females were less likely than males to engage in physical exercise of at least moderate intensity at least once a week (Adjusted OR = 0.74; 95% CI: 0.60 - 0.91; p = 0.0039). Compared to participants with less than high school education, participants with high school diploma and those who had some college education (Adjusted OR = 1.45; 95% CI: 1.02 - 2.05; p = 0.0375), as well as those with at least a college degree (Adjusted OR = 2.23; 95% CI: 1.51 - 3.29; p <.0001) were more likely to engage in some moderate intensity exercise at least weekly. Participants in the 65+ age group were less likely to engage in moderate intensity exercise weekly (Adjusted OR = 0.37; 95% CI: 0.26 - 0.52; p <.0001). Blacks were also less likely to engage in moderate intensity exercise every week (Adjusted OR = 0.67; 95% CI: 0.51 - 0.88; p = 0.0038).

Participants who earned $100,000 or above were more likely to engage in muscle training exercises at least weekly (Adjusted OR = 1.25; 95% CI: 0.89 - 1.77; $p = 0.0061$). Females were less likely than males to engage in muscle strength training at least once a week (Adjusted OR = 0.75; 95% CI: 0.63 - 0.89; $p = 0.0009$), and participants in the 65+ age group were less likely to engage in weekly muscle training exercises (Adjusted OR = 0.52; 95% CI: 0.40 - 0.69; $p < .0001$). Overall, level of education was directly and significantly correlated with participation in moderate intensity exercise but not with muscle strength training.

After including and controlling for disability in our additional models, immigrants were still more likely than native born respondents to engage in physical activity of at least moderate intensity, at least once a week (Adjusted OR = 1.46 ; 95% CI: 1.05 - 2.02; $p = 0.0242$). Furthermore, after controlling for disability in our models, immigrants were still more likely than native-born participants to engage in muscle strength training at least one day per week but the association was not statistically significant (Adjusted OR = 1.266; 95% CI: 0.97 - 1.66; $p = 0.0867$).

CHAPTER V: DISCUSSION AND CONCLUSION

5.1 Discussion of Research Questions

One of the aims of the current thesis was to describe the demographics of the survey participants by nativity status. A continued look at the demographics of immigrants will produce a better understanding of the impact of recent immigration, and serve as a strategy for appraisal of policies related to immigrants and immigration. It is known that immigrants currently make up about one-sixth of the U.S. population and this was reflected in the composition of participants in the HINTS 4 Cycle 3 survey which included roughly 17% immigrants.

The results of the current analysis showed that most immigrants were Hispanic, corroborating previous reports that Mexicans make up the largest population of immigrants to the U.S. As an example, more than four million Mexicans immigrated to the U.S. between 2000 and 2010.[28] The analysis also showed that compared to native-born respondents, a greater proportion of immigrants had college degrees or higher level of education. Historically, compared to native-born residents, U.S. immigrants have been known to enjoy a benefit regarding having at least a college level of education. Interestingly, our analysis also revealed that a much greater proportion of immigrants had less than high school diploma compared to the proportion among non-immigrants. This finding has also been previously documented in the 2011 Current Population Survey (CPS) which showed roughly 28% of immigrants aged 25 to 65 years (compared to an estimated 7% of non-immigrants) without high school certificate**.**[28] Level of education is a strong predictor of socio-economic class. It is therefore not surprising to have observed in our analysis that compared to their native-born counterparts, a greater proportion of the immigrant participants were of lower socio-economic status: a higher percentage of

immigrants were unemployed, and a lower percentage reported home ownership. Furthermore, among participants who were employed, a higher proportion of immigrants had an annual income less than $50,000. These findings support previous studies that have documented lower income and higher poverty rates and welfare use among immigrants compared to native-born U.S. residents.[28] Notwithstanding that a large proportion of immigrants have low level of education, most immigrants are gainfully employed as shown by the result of this analysis and by prior research.[28]

The alarmingly trends of obesity in the U.S. was apparent in our results. An estimated 34.4% of native-born participants were obese, reflecting the current reported obesity prevalence rate of 34.9%.[48] Although lower than the proportion among non-immigrants, a 25% proportion of obese participants among immigrants is a cause for concern. Public health attention should continually be directed at reducing obesity prevalence across board. The higher proportion of underweight observed among immigrant participants could reflect the heterogeneity of country of origin; many immigrants originate from developing countries with high poverty levels and food scarcity due to famine.

Our bivariate analyses showed that proportions for indicators of diet were similar or close between the 2 groups of interest: some daily fruit intake (93.05% among immigrants vs 92.09% among non-immigrants), some daily vegetable intake (94.79% among immigrants vs 95.18% among non-immigrants), and some weekly soda intake (7.28% among immigrants vs 9% among non-immigrants). However, following adjustments in multivariable analyses, immigrants were significantly more likely than non-immigrants to take fruits daily and significantly less likely to take soda every week. This trend follows current recommendations for healthy living by various advocates. Concurrently, the observed indicators of physical activity showed that immigrants

were more likely to engage in physical activity of at least moderate intensity at least once a week, as well as less likely to spend 6 or more hours on TV, games and web surfing. In a prior study of low-income, minority families, Cespedes et al (2013) had reported that "non-US-born (vs US-born) parents had less screen exposure."[34] Considering the specific directions of these proximal determinants of obesity among immigrant participants, it is not surprising that most immigrants were in the normal weight category compared to most native-born participants in the obese category. The specific directions of dietary and physical activity behavior observed among immigrants in this cohort also very likely contribute to the well-documented lower risk of obesity among U.S. immigrants.

Notwithstanding the finding that immigrants in the survey engage in healthier dietary behavior and more physical activity than native-born respondents, it is noteworthy that up to 7% and 5% of participants have no daily intake of fruits and no daily intake of vegetables respectively. Furthermore, 16 - 19% of participants consume soda on 3 or more days per week. Evidence based research has progressively showed that intake of fruits and vegetables is critical to promotion of good health and that diets rich in fruits and vegetables reduce the risk of obesity, cancer and other chronic diseases.[49] Furthermore, soda is one of the major sources of added sugars in the diet of the American populace and excess sugar intake has been linked to numerous metabolic problems, adverse health outcomes and deficits of essential nutrients. The American Heart Association (AHA) recommends that notwithstanding intake of diets rich in fruits and vegetables, minimizing intake of beverages and foods with added sugars is necessary for healthy living.[50]

Moreover, up to 22% and 26% of immigrants and native-born respondents respectively did not engage in any physical exercise of at least moderate intensity on at least a weekly basis;

and roughly 54% and 57% of immigrant and native-born participants respectively did not engage in any muscle training exercise. These numbers are quite concerning, considering the amount of flexibility woven into the current guidelines for physical activity for Americans. Current recommendations are 150 minutes of moderate exercise per week and at least two days of muscle training exercise per week. Public health researchers and practitioners need to continue vigorous education initiatives and policy makers need to enact policies that promote greater levels of physical activity among the populace.

Unfortunately, effects of acculturation among the study participants could not be assessed due to the small sample size of immigrants who have lived in the U.S. for 15 or more years which under-powered the analysis. Future studies

5.2 Study Strengths and Limitations

To our knowledge, our analysis is the first detailed review of dietary and physical activity behavior comparing immigrants and native-born U.S. adults. The HINTS dataset has been validated to capture a representative proportion of U.S. adults regarding their health practices including diet and physical activity behavior. Nonetheless, our findings have important limitations that should be considered. The retrospective nature of this thesis limits our ability to full control for potential biases and confounders. Participants included in the dataset cannot be followed longitudinally to determine long term outcomes. Social and personal factors of the participants that influenced the choice of specific health and dietary behaviors cannot be ascertained from the analysis of this dataset. Although we observed missing data with a number of the variables utilized, the amount of missing data was small and is unlikely to significantly alter the findings from these analyses. Notwithstanding the above-stated limitations, this study

provides a great insight into major differences in dietary and physical activity behavior between U.S. immigrants and non-immigrants, and serves as a template on which more robust studies on obesity-related behavior can be built.

5.3 Conclusion and Recommendations

Analysis of proximal determinants of obesity among immigrant and native-born U.S. adults showed the association of healthy lifestyle and behavioral choices with lower proportions of obesity among immigrants. In the general cohort, increase in age was significantly associated with increase in obesity-related behavior, while higher levels of education and higher income were associated with decrease in obesity-related behavior.

Previous studies have shown that notwithstanding obesity risk status, most individuals will derive benefits from better nutrition, healthy eating choices and increased levels of physical activity. Public health researchers and practitioners need to continue to educate the general public about the health benefits of healthy diets and physical activity in various forms, while policy makers need to continue to promote policies that make it easier for the general public to engage in positive health behavior. Researchers, practitioners and policy makers need to develop targeted strategies and focus attention on keeping immigrants in the loop of positive health behavior, encouraging older adults to engage in more physical activity, and increasing the level of education and the earning power of the general public.

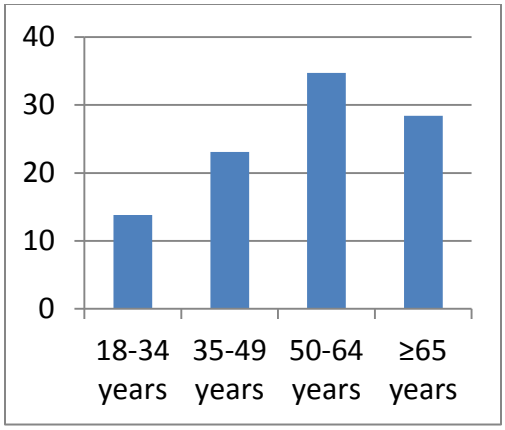
A significant number of acculturation studies highlighted the role of community identity and homogeneity in integration of immigrants in their host environments. Immigrants who stay together tend to assimilate the sociocultural milieu less than their counterparts living in mixed neighborhoods. Community activation can therefore be an influential social mechanism in

promoting active lifestyles among immigrants. Grassroots efforts can exploit the social fabric among immigrants to perpetuate proximal determinants that protect against obesity among newly arrived immigrants, and encourage longer-stay immigrants towards reduction in obesity risks.

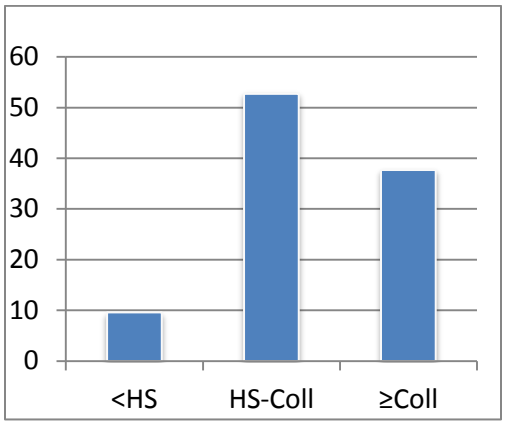
The recent attempts to reward healthy lifestyle choices in the economic models of insurance policies should be tailored to facilitate favorable proximal determinants among immigrants. Most insurance policies currently have lower premiums for non-smokers, and incentives targeting healthy diets and physical activity among their clientele. The factors identified in this study can be integrated in medical, life and other insurance policies towards promoting behavioral characteristics that prevent development of obesity.

Prospective studies with larger samples and adequate follow up of immigrants from time of entry into the U.S. onwards are crucial in exploring the role of various social, economic, cultural and demographic factors while eliminating the apparent biases of a retrospective analysis. Also, the advantages of focus group discussions among immigrants can be harnessed and would include more accurate evaluation of the role of proximal determinants of obesity in increased obesity risks with increased length of stay of immigrants in the U.S. Additionally, studies limited to participants from specific ethnic, racial and nationality groups would enable a more robust mechanism for ascertaining the impact of demographic characteristics on obesity risks. Future research embracing these types of studies would be useful in expanding knowledge and understanding of elements that may differentiate U.S. immigrants from native born from adults in their propensity for developing obesity.

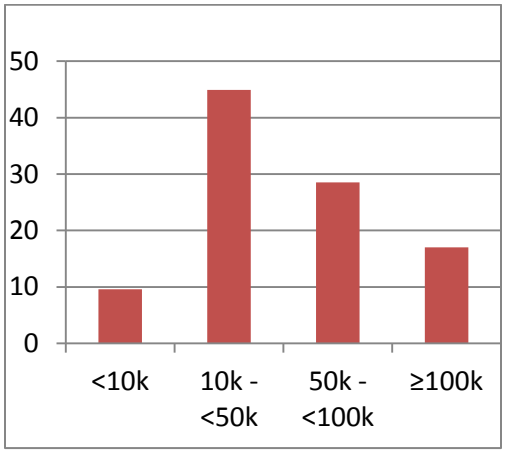
Figure 1: Distribution of demographic characteristics among participants in HINTS 4 cycle 3.



1A: Age distribution

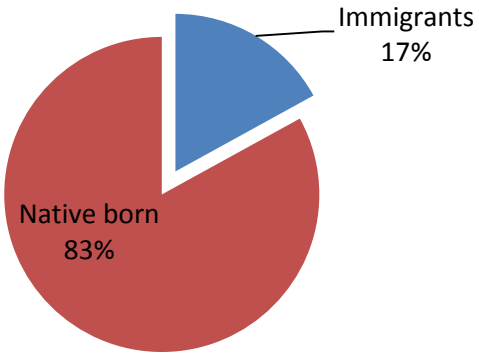


1B: Level of Education

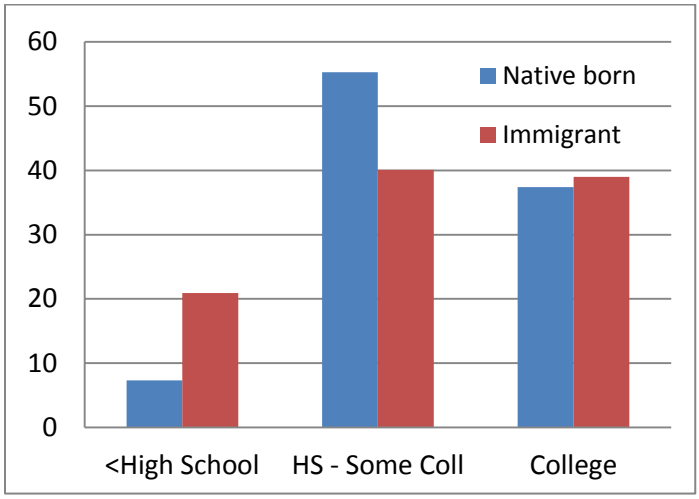


1C: Income ranges

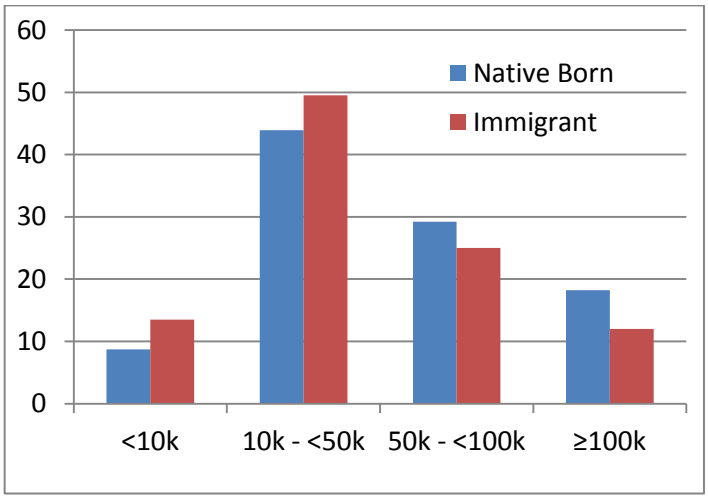
Figure 2: Distribution of demographic characteristics by nativity status of participants in HINTS 4 cycle 3.



2A: Nativity status



2B: Level of Education



2C: Income ranges

Figure 3: Weight distribution by nativity status of participants in HINTS 4 cycle 3.

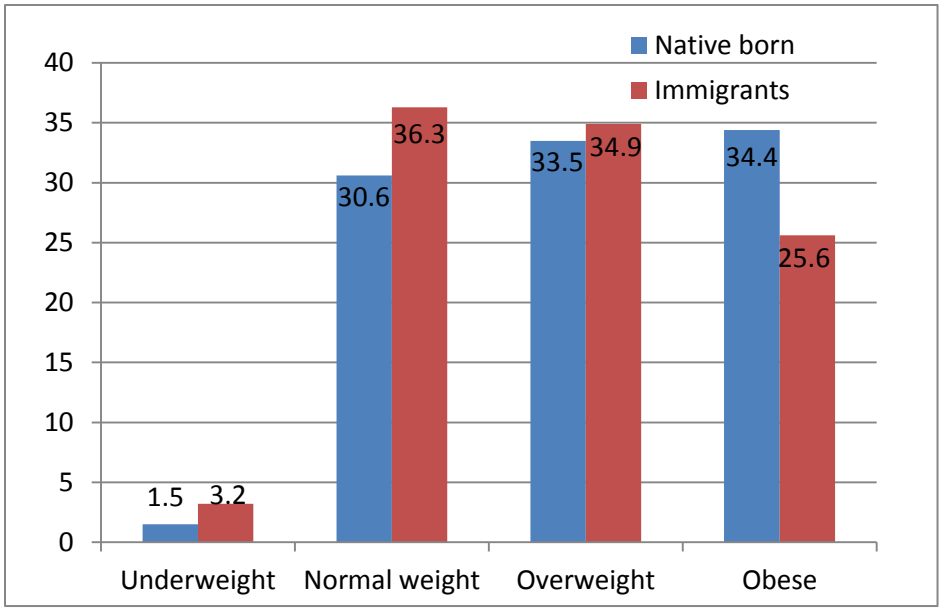


Table 1: Demographic characteristics by nativity status of participants in HINTS 4 cycle 3.

Participant Characteristics	Immigrant (17%) n = 533	Native born (83%) n =2598	Total* n = 3131	*P*-value**
Age in years[†]				
Mean (Min - Max)	51.25(18-92)	55.39(18-105)	3082	
Gender				
Male	214 (40.92)	969 (37.97)	1183	0.21
Female	309 (59.08)	1583 (62.03)	1892	
Age group				
18 to 34	78 (14.91)	348 (13.62)	426	<.0001
35 to 49	177 (33.84)	533 (20.86)	710	
50 to 64	161 (30.78)	907 (35.50)	1068	
65 or more	107 (20.46)	767 (30.02)	874	
Race/Ethnicity				
Hispanic	263 (55.25)	248 (11.03)	511	<.0001
Non-Hispanic White	70 (14.71)	1513 (67.30)	1583	
Non-Hispanic Black	47 (9.87)	374 (16.64)	421	
Non-Hispanic Asian	90 (18.91)	24 (1.07)	114	
Others ***	6 (1.26)	89 (3.96)	95	
Level of education				
Less than high school	110 (20.91)	187 (7.28)	297	<.0001
High school graduate or some college	211 (40.11)	1419 (55.28)	1630	
College graduate or higher	205 (38.97)	961 (37.44)	1166	
Marital Status				
Married or living as married	313 (59.85)	1280 (50.02)	1593	<.0001
Not married and not living as married	210 (40.15)	1279 (49.98)	1489	
Occupation Status				
Employed	282 (54.86)	1299 (51.69)	1581	<.0001
Unemployed	57 (11.09)	124 (4.93)	181	
Retired	92 (17.90)	710 (28.25)	802	
Others****	83 (16.15)	380 (15.12)	463	
Income ranges				
Less than $10,000	64 (13.53)	196 (8.70)	260	<.0001
$10,000 to $49, 999	234 (49.47)	989 (43.88)	1223	
$50,000 to $99,999	118 (24.95)	659 (29.24)	777	
$100,000 or more	57 (12.05)	410 (18.19)	467	
Home ownership				
Owns home	246 (48.24)	1719 (69.15)	1965	<.0001
Does not own home	264 (51.76)	767 (30.85)	1031	

[†] Continuous variable; Min – max = minimum age to maximum age; *Missing values were excluded from all analyses; **Wald Chi-Square tests (categorical variables) and t test (continuous variable) for differences in distributions of selected demographic variables by nativity status; ***Race category 'others' includes American Indian, Alaska Native, Pacific Islander and others; ****Occupation status 'others' includes homemaker, student, disabled and others.

Table 2: Distributions of selected variables (indicators of dietary behavior and physical activity level, and BMI) by nativity status of participants in HINTS 4 cycle 3.

Selected Variables	Immigrant (17%) n = 533	Native-born (83%) n = 2598	Total† n = 3131	*P*-value††
Daily Fruit intake*				
None	36 (6.95)	202 (7.91)	238	0.1962
Up to 1 cup per day	222 (42.86)	1128 (44.15)	1350	
1 to 3 cups per day	231 (44.59)	1033 (40.43)	1264	
3 or more cups per day	29 (5.60)	192 (7.51)	221	
Daily Vegetable intake*				
None	27 (5.20)	123 (4.81)	150	0.6147
Up to 1 cup per day	210 (40.46)	1013 (39.63)	1223	
1 to 3 cups per day	229 (44.12)	1195 (46.75)	1424	
3 or more cups per day	53 (10.21)	225 (8.80)	278	
Soda intake*				
None	195 (37.36)	1082 (41.95)	1277	0.0557
Less often than 1 day a week	143 (27.39)	594 (23.03)	737	
1-2 days a week	97 (18.58)	402 (15.59)	499	
3-4 days a week	38 (7.28)	192 (7.44)	230	
5-6 days a week	11 (2.11)	77 (2.99)	88	
Every day	38 (7.28)	232 (9.00)	270	
Average daily hours spent sitting (TV/movies/web/computer games)**				
None	18 (3.67)	43 (1.73)	61	<.0001
Less than 5 hours per day	394 (80.41)	1782 (71.77)	2176	
5 to 14 hours per day	73 (14.90)	617 (24.85)	690	
15 or more hours per day	5 (1.02)	41 (1.65)	46	
Physical activity of moderate intensity per week**				
None	118 (22.61)	673 (26.28)	791	0.1768
1 to 3 times per week	217 (41.57)	982 (38.34)	1199	
4 or more times per week	187 (35.82)	906 (35.38)	1093	
Length of exercise per day of exercise***				
Less than 30 minutes per day	64 (25.20)	233 (20.71)	297	0.1420
30 to 60 minutes per day	186 (73.23)	857 (76.18)	1043	
More than 60 minutes per day	4 (1.57)	35 (3.11)	39	
Total***	254	1125	1379**	
BMI categories				<.0001
Underweight (<18.5**)**	16 (3.21)	36 (1.43)	52	
Normal weight (18.5-24.9**)**	181 (36.27)	773 (30.63)	954	
Overweight (25-29.9**)**	174 (34.87)	846 (33.52)	1020	
Obese (≥30)	128 (25.65)	869 (34.43)	997	

*Indicator of dietary behavior; **Indicator of physical activity behavior; ***This particular analysis included only participants who had indicated taking part in moderate intensity exercise at least once a week; †Missing values were excluded from all analyses; †† Wald Chi-Square tests were used for differences in distributions of selected variables by nativity status.

Table 3: Adjusted logistic regression analyses for associations between nativity status and three separate indicators of dietary behavior among participants in HINTS 4 cycle 3.

	Daily fruit intake*		Daily vegetable intake*		Weekly soda intake*	
Participant Characteristics	**AOR** (95% CI)**	***P*-VALUE**	**AOR** (95% CI)**	***P*-VALUE**	**AOR** (95% CI)**	***P*-VALUE**
Immigrant status						
Native-born	Ref		Ref		Ref	
Immigrant	1.88 (1.07-3.32)	0.0290	1.29 (0.68-2.47)	0.4372	0.74 (0.55-0.98)	0.0383
Gender						
Male	Ref		Ref		Ref	
Female	1.13 (0.81-1.57)	0.4827	1.76 (1.17-2.65)	0.0065	0.60 (0.50-0.72)	<.0001
Age group						
18 – 34	Ref		Ref		Ref	
35 – 49	0.64 (0.37-1.11)	0.1098	0.91 (0.47-1.76)	0.7716	0.87 (0.65-1.17)	0.3635
50 – 64	0.71 (0.42-1.18)	0.1862	0.942 (0.51-1.76)	0.8505	0.56 (0.43-0.74)	<.0001
65+	1.08 (0.61-1.93)	0.7842	1.09 (0.56-2.14)	0.8034	0.38 (0.29-0.51)	<.0001
Ethnicity						
Non-Hispanic White	Ref		Ref		Ref	
Non-Hispanic black	1.14 (0.71-1.84)	0.5959	0.76 (0.43-1.32)	0.3229	2.76 (2.08-3.64)	<.0001
Hispanic	0.78 (0.48, 1.25)	0.3012	0.83 (0.45-1.53)	0.5514	2.00 (1.50-2.65)	<.0001
Non-Hispanic Asian	0.78 (0.29-2.14)	0.6337	0.57 (0.20-1.63)	0.2899	1.45 (0.91-2.33)	0.1216
Others	0.85 (0.40-1.85)	0.6872	0.74 (0.28-1.93)	0.5332	1.19 (0.76-1.87)	0.4467
Level of education						
Less than high school	Ref		Ref			
High school graduate or some college	1.41 (0.82-2.42)	0.2096	1.82 (0.99-3.34)	0.0535	0.87 (0.61-1.26)	0.4685
College graduate or more	2.19 (1.16-4.09)	0.0137	2.31 (1.13-4.73)	0.0217	0.57 (0.39-0.84)	0.0044
Marital Status						
Not married and not living as married	Ref		Ref			
Married or living as married	1.18 (0.83-1.67)	0.3471	1.14 (0.74-1.76)	0.5583	1.18 (0.98-1.43)	0.0806

	Daily fruit intake*		Daily vegetable intake*		Weekly soda intake*	
Participant Characteristics	**AOR** (95% CI)**	***P*-VALUE**	**AOR** (95% CI)**	***P*-VALUE**	**AOR** (95% CI)**	***P*-VALUE**
Income ranges						
Less than $10,000	Ref		Ref			
$10,000 – $49,999	0.84 (0.48-1.45)	0.5264	1.29 (0.70-2.38)	0.4064	1.07 (0.77-1.50)	0.6817
$50,000 - $99,999	1.18 (0.62-2.24)	0.6074	1.95 (0.92-4.12)	0.0795	0.81 (0.56-1.17)	0.2629
$100,000 or more	1.90 (0.85-4.22)	0.1157	2.575 (1.00- 6.58)	0.0481	0.52 (0.34- 0.78)	0.0015

*Indicator of dietary behavior selected as an outcome variable; AOR= Adjusted Odds Ratio; **Adjusted for gender, age group, race/ethnicity, level of education, marital status and income ranges; 95% CI= 95 percent confidence interval; Ref = Reference category; Missing values were excluded from all analyses.

Table 4: Adjusted logistic regression analyses for associations between nativity status and three separate indicators of physical activity behavior among participants in HINTS 4 cycle 3.

	TV/ GAMES/WEB ≥ 6 HOURS PER DAY*		MODERATE INTENSITY EXERCISE (AT LEAST ONE DAY PER WEEK)*		MUSCLE STRENGTH TRAINING (AT LEAST ONE DAY PER WEEK)*	
Participant Characteristics	**AOR** (95% CI)**	***P*-VALUE**	**AOR** (95% CI)**	***P*-VALUE**	**AOR** (95% CI)**	***P*-VALUE**
Immigrant status						
Native-born	Ref		Ref		Ref	
Immigrant	0.64 (0.42-0.97)	0.0350	1.48 (1.07-2.05)	0.0192	1.28 (0.98-1.67)	0.0757
Gender						
Male	Ref		Ref		Ref	
Female	0.92 (0.72-1.17)	0.4982	0.74 (0.60-0.91)	0.0039	0.75 (0.63-0.89)	0.0009
Age group						
18 – 34	Ref		Ref		Ref	
35 – 49	0.969 (0.64-1.47)	0.8813	0.54 (0.38-0.77)	0.0006	0.85 (0.65-1.11)	0.2348
50 – 64	1.44 (0.995-2.098)	0.0535	0.58 (0.42-0.82)	0.0016	0.67 (0.52-0.86)	0.0016
65+	1.71 (1.16-2.52)	0.0066	0.37 (0.26-0.52)	<.0001	0.52 (0.40-0.69)	<.0001
Ethnicity						
Non-Hispanic White	Ref		Ref		Ref	
Non-Hispanic black	1.73 (1.28-2.35)	0.0004	0.67 (0.51-0.88)	0.0038	1.09 (0.85-1.40)	0.4813
Hispanic	0.84 (0.57-1.24)	0.3897	0.77 (0.57-1.04)	0.0911	0.97 (0.76-1.28)	0.9155
Non-Hispanic Asian	1.45 (0.72-2.93)	0.2973	0.64 (0.37-1.11)	0.1120	0.75 (0.47-1.19)	0.2247
Others	2.05 (1.21-3.46)	0.0075	0.87 (0.52-1.45)	0.5892	1.48 (0.95-2.29)	0.0817
Level of education						
Less than high school	Ref		Ref			
High school graduate or some college	0.89 (0.59-1.33)	0.5568	1.45 (1.02-2.05)	0.0375	0.96 (0.68-1.34)	0.7951
College graduate or more	0.48 (0.30-0.77)	0.0022	2.23 (1.51-3.29)	<.0001	1.21 (0.84-1.74)	0.3004
Marital Status						
Not married and not living as married	Ref		Ref			
Married or living as married	0.84 (0.66-1.08)	0.1830	1.00 (0.81-1.24)	0.9969	0.71 (0.59-0.85)	0.0002

	TV/ GAMES/WEB ≥ 6 HOURS PER DAY*		MODERATE INTENSITY EXERCISE (AT LEAST ONE DAY PER WEEK)*		MUSCLE STRENGTH TRAINING (AT LEAST ONE DAY PER WEEK)*	
Participant Characteristics	**AOR** (95% CI)**	***P*-VALUE**	**AOR** (95% CI)**	***P*-VALUE**	**AOR** (95% CI)**	***P*-VALUE**
Income ranges						
Less than $10,000	Ref		Ref			
$10,000 – $49,999	1.03 (0.70-1.52)	0.8701	0.79 (0.56-1.12)	0.1876	0.97 (0.71-1.32)	0.8412
$50,000 - $99,999	0.66 (0.42-1.04)	0.0733	1.01 (0.68-1.50)	0.9625	1.72 (1.17-2.53)	0.1979
$100,000 or more	0.45 (0.26-0.80)	0.0061	1.23 (0.78-1.96)	0.3719	1.25 (0.89-1.77)	0.0061

*Indicator of physical activity behavior selected as an outcome variable; AOR= Adjusted Odds Ratio; **Adjusted for gender, age group, race/ethnicity, level of education, marital status and income ranges; 95% CI= 95 percent confidence interval; Ref = Reference category; Missing values were excluded from all analyses.

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